OAHU MUNICIPAL REFUSE DISPOSAL ALTERNATIVES STUDY

ANALYSIS OF RESIDENTIAL CURBSIDE RECYCLING

APRIL 1999

PREPARED FOR:

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Department of Environmental Services
Refuse Division
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INTRODUCTION

1.1 PROJECT OVERVIEW

This report was prepared for the City & County of Honolulu (City), Department of Environmental Services, Refuse Division. This evaluation was conducted as part of an overall study addressing six key areas of the City's waste collection and diversion programs. This introduction provides a summary of the solid waste system when the evaluation was conducted.

The evaluations were conducted by R. M. Towill Corporation (RMTC) in association with Solid Waste Associates (SWA), which provided project management support and prepared two evaluations. Other companies that participated in the evaluation are listed below.

The six evaluations were:

- A *Waste Composition Analysis* of the residential, commercial, and self–haul waste streams. This analysis was conducted by Cascadia Consulting Group, Inc., and Sky Valley Associates. They were assisted by SWA.
- A *Study of Managed Competition* in waste collection and transfer services. This study was prepared by HDR Engineering, Inc.
- An *Evaluation of Green Waste Collection, Processing, and Marketing* to address the infrastructure needed for expanded green waste collection. This evaluation was prepared by Total Compliance Management, Inc., in association with SWA.
- An *Evaluation of Curbside Recyclable Collection* from single–family dwellings. This evaluation, conducted by Franklin Associates, was to determine the cost of implementing a curbside program compared to the existing drop-off system.
- An *Evaluation of Emerging Waste Management Technologies* to identify those that might be appropriate for the City to investigate further. This evaluation was prepared by ATG, Inc.
- An *Evaluation of Market Subsidies for Recyclable Materials* prepared by Skumatz Economic Research Associates (SERA).

1.2 EXISTING SYSTEM

1.2.1 General

These reports are based on conditions that existed between January 1998 and September 1998. The data on the waste collection, diversion, and disposal systems were for 1997, the

latest full year for which data were available. The waste composition information was taken between April 1998 and September 1998. The waste sampling schedule for the waste composition study was based on 1997 disposal amounts and vehicle counts at the facilities to be sampled. The 1997 data used to prepare the sampling program were checked against the actual disposal in 1998 to confirm that the 1997 data were representative of 1998.

While the data for 1997 were determined to be adequately representative of the 1998 disposal for waste composition sampling plan purposes, the amount of disposal at the City's disposal facilities has decreased in 1998. The amount of waste handled at the Waimanalo Gulch Landfill and at H–Power in the last two fiscal years is shown in Table 1–1, Changes in Amount of Waste Disposal. The increase at H-POWER was due to increased availability of the plant not an increase in waste generation.

Table 1–1
Changes in Amount of Waste Disposal

	H–POWER	Waimanalo Gulch Landfill	Total
FY 96-97	588,939	385,248	974,187
FY 97-98	639,286	278,374	917,660
Difference	9%	-28%	-6%

1.2.2 Collection System

The City & County is divided into seven collection districts. Waste from the districts is either sent through one of three transfer stations or directly to the disposal site, depending on distance from the route to the disposal point.

The Refuse Division collects waste from single–family dwellings and from some apartment buildings and commercial facilities. Waste from most commercial facilities and apartments is collected by private waste haulers.

Residential waste is collected twice per week. In areas with automated collection services, green waste is collected separately once per month in some districts. On–call green waste collection in some automated areas is provided due to the large amount of the material that is generated. In areas with manual collection, green waste is collected with the rubbish.

Both automated and manual trucks are used for waste collection. About 40 percent of the routes are automated. The Refuse Division staff anticipates converting a total of about 80 percent of the routes to automated collection over the next several years. In the automated areas, green waste is collected with manual trucks.

The City operates a system of six convenience centers where householders can drop off waste. The centers have bins designated for recycling, H–POWER, and landfill. The customer places the waste in the proper bin.

1.2.3 Diversion

The waste diversion program includes the following components:

- A drop–off system currently located at schools around the island. Materials collected include paper, plastic, aluminum cans, and glass. The drop–off system is being expanded to additional schools and some commercial facilities, such as grocery stores.

- Green waste processing is done at three locations, two private operations and one operated by the Refuse Division (located at the Kapaa Landfill). The private operations produce both mulch and compost. The finished product is marketed in retail stores and in wholesale bulk. The Refuse Division operation produces mulch, which is provided free to the City parks and other departments and to the public.

- A statewide advanced disposal fee for glass provides an incentive for recycling that material. A fee of 1.5 cents is collected for each glass container entering the state. The processor is paid six cents per pound (or three cents per container) for the recycled glass.

- The Partnership for the Environment is a City supported organization comprised of representatives of companies that have extensive commercial recycling activities. The Partnership acts as an information source for expanding commercial recycling in the City.

- The City requires recycling of glass containers from bars and restaurants. It also requires office buildings greater than 20,000 square feet in size to recycle office paper, newspaper, and cardboard.

- Restaurants and other facilities that generate food waste are required to recycle that material.

- The City has a program to recycle materials from its offices.

- While not City sponsored, there are programs to recycle construction and demolition waste, tires, and appliances.

1.2.4 Disposal

The City operates two disposal facilities, and a third is privately operated. The City facilities are the Waimanalo Gulch Landfill and H–POWER. H–POWER is a waste–to–energy plant that processes over 620,000 tons of waste per year (about 2,000 tons per day) and generates electricity. The facility is a refuse derived fuel plant that recycles ferrous metals from the front end processing equipment and ferrous and non–ferrous metals from the ash.

The Waimanalo Gulch Landfill accepts non–combustible waste including the ash from H–POWER and other materials, mostly from private waste haulers and self-haulers. The public does not pay for waste disposal. Commercial customers pay $65.75 per ton, which includes a state tax of $0.35 per ton and a six-percent City recycling surcharge. On July 1, 1999 the fee will become $72.25 per ton.

PVT Land Company operates the private landfill. It accepts construction and demolition materials at a tip fee of $25 per ton.

1.3 EXISTING RECYCLING

The City and County of Honolulu (City) does not currently have any residential curbside recycling programs. In the early 1990s, the City conducted a number of different pilot recycling projects including an 18-month curbside collection study. The trial curbside recycling project was reported as successful in terms of participation but was considered too costly. Instead, the City established numerous drop-off recycling sites, which are located on the grounds of public and private schools located throughout the city. The drop-off system is being expanded to additional schools and some commercial facilities such as grocery stores. In addition to recovery through the drop-off sites, aluminum and steel cans are recovered from the residential solid waste taken to H-POWER, which combusts the organic materials to generate electricity.

Despite the extensive system of drop-off recycling sites and the recovery of metal cans at H-POWER, the City chose to examine curbside recycling again as part of the Oahu Municipal Refuse Disposal Alternatives Study. The results of that examination are presented in the sections that follow. Information presented includes the variations of curbside recycling programs that could be used, projected quantities of recyclables that could be collected, expected revenues from the sale of the recovered recyclables and the estimated costs for programs deemed most appropriate for use in Honolulu. Single-family household solid waste management costs for various systems with and without curbside recycling are summarized. Factors other than costs that can affect a decision on whether to implement curbside recycling are briefly discussed as well. The final section of the report contains the consultant's conclusions relative to the viability of implementing curbside recycling in Oahu.

The markets for recycled materials will also effect the cost of a curbside recycling program. Sale of the materials collected adds revenue to the program and reduces the cost to the householder. Markets for recycled materials on Oahu are completely dependent on shipping to other states or countries. Local end-users for materials do not exist in sufficient size to use the quantity of materials that could be collected. The possibility of new end-users becoming available is limited because they need a larger supply of materials than is available here. As a result, the materials must be shipped to market. The cost of shipping significantly reduces the revenue from sale of materials.

SECTION 2
REVIEW OF CURBSIDE RECYCLING ALTERNATIVES

2.1 COLLECTED MATERIALS

Choosing the materials to collect in a curbside recycling program is a function of several factors including:

- The level of recovery desired
- The availability of sufficient quantities to warrant collection
- The availability of markets for the materials
- The ability to collect and process the materials
- The net costs of adding the materials to the recycling program
- The compatibility of the proposed program with the existing system

In some communities, the goal is to maximize recycling even at substantial cost. This frequently leads to including virtually any residential recyclable in the recycling program if it can be collected and there is a market for it.

When prices paid for recyclables are relatively high—such as those experienced in 1995—maximizing the materials collected in a recycling program can be the most cost-effective approach. The incremental cost in 1995 of recovering mixed paper, for example, was generally less than the sum of the price obtained for the paper and the savings from avoided disposal. More recently, adding mixed paper to a curbside recycling program would likely not be cost effective and would be justified only to achieve a desired (or mandated) recovery/diversion level.

Most curbside recycling programs collect, at least, old newspapers, steel and aluminum cans, glass containers, and plastic beverage containers (i.e., PET soft drink and other carbonated beverage containers and HDPE milk, water and juice containers). Although volatile, markets for these materials are nearly always available.

Other materials that are often collected in curbside recycling programs include old magazines; old corrugated containers (OCC); mixed paper including mail, cereal boxes, etc.; non-beverage PET and HDPE containers and, occasionally, other plastic containers. Inclusion of these less frequently collected materials may, in some cases, be influenced by the availability of nearby markets. For example, the availability of a manufacturer that uses

a variety of plastic resins for structural use products can be a factor in the types of plastic containers collected. Unfortunately, end-user markets for recyclable materials are generally nonexistent on Oahu.

2.2 COLLECTION FREQUENCY

The frequency with which materials are collected from households in a curbside recycling program varies from once per week to as little as once per month.[1] In general, it appears that weekly collection results in higher recovery rates than biweekly or monthly collection.[2] Households may find it more difficult to remember the recyclables collection day when it is biweekly or monthly and may have difficulty storing the greater quantity of materials as well. This can lead to fewer households participating in the program and a decrease in the materials they set out. However, other factors also affect the level of household participation and recovery, including the number of materials accepted—more materials lead to higher participation—and the methods used to collect the materials.

2.3 COLLECTION METHODS

A wide variety of methods have been used to collect household recyclables at the curb. Recyclable materials may be placed at the curb in bags, bins, or carts with lids. Vehicles used to collect the materials have included small trucks pulling trailers, enclosed-body non-compaction trucks divided into multiple compartments, rear-loading and side-loading packer trucks, and trucks with non-compaction compartments for recyclables and a compaction compartment for refuse.

The materials may be commingled when placed at the curb or source-separated into designated components. In some programs, commingled materials will be sorted by the collection crew and placed in assigned truck compartments. Sorting the materials prior to delivery to the processing facility is more common in smaller programs. In larger programs, it is common to see old newspapers (and other paper, if any) bundled, bagged or otherwise kept separate from commingled containers.

Co-collection of household recyclables with refuse has been used in an effort to reduce costs. The most common approach has been to collect the recyclables in plastic bags (of a specific color) and place them in the same truck compartment as the refuse. The bags of recyclables are then separated at a transfer station, which is, typically, designed to process

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[1] Sorting Out Split Containers. BioCycle. September 1998.
[2] Skumatz, Lisa A. Beyond Case Studies: Quantitative Effects of Recycling and Variable Rate Programs. Resource Recycling. September 1996.

the recyclables as well. Although this approach lowers collection costs from that of separate collections of refuse and recyclables, processing costs are higher and the potential exists for greater contamination of the recovered materials. Also, public skepticism of this form of recyclables collection has been blamed for low participation levels in some of the more prominent instances where it has been used. In Chicago, for example, participation in their co-collection program is reported at 33 percent[3]—a very low level.

Other methods of co-collection use different compartments on the same vehicle. Recently, split carts of, typically, 90 gallons or larger have been used by households for storing both refuse and recyclables. Refuse is placed on one side of the cart and commingled recyclables on the other. A fully automated or semi-automated truck with dual compartments collects these two streams, which remain separated in the truck.

Large carts may also be used to collect recyclables only. In a split cart, paper can be placed on one side of the cart and commingled containers on the other. The City of Milwaukee services about 170,000 households with this system.[4] They have reported participation in their curbside recycling program at 85 percent with collection once per month. An initial problem of contamination in one area of the city with a high transient population was solved by reverting to the bin program used previously in that area.

Another option is to use a cart without a divider wall—i.e., the same type of cart that would be used for refuse—to collect a single stream of commingled materials. The City of Los Angeles tested the split cart and single-stream cart for recyclables collection and chose the 90-gallon single-stream cart for its curbside recycling program.[5] Both collection methods resulted in substantially higher recovery rates. Although the single-stream approach resulted in higher contamination and increased processing costs, it was chosen because it led to the highest recovery rate and the City could use the same trucks used for refuse collection.

Mounting evidence exists that the use of carts increases participation and recovery rates in curbside recycling programs.[6] [7] In addition to the evidence from Los Angeles, other U.S. cities, including Milwaukee and Tallahassee, have reported increased participation and

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[3] Biddle, David. Growing Curbside Efficiencies. Biocycle. July 1998.
[4] Sorting Out Split Containers. Biocycle. September 1998.
[5] Plews, Shirley. L.A. Recycles: The Next Generation. World Wastes. July 1997.
[6] Egan, Katharine. Can Biweekly Recycling Collection Work? Waste Age. May 1998.
[7] Apotheker, Steve. Recycling In The Big Three: An Update. Resource Recycling. December 1997.

recovery when switching from 14- or 18-gallon bins to carts of the 60- to 90-gallon variety. These larger storage receptacles are generally more than adequate to easily store all of a household's recyclables over even a two-week period. In addition, certain materials such as old corrugated boxes may not have to be cut up to fit in the carts. The use of carts—instead of the much smaller manually handled bins—requires automated trucks for collection, but may allow biweekly instead of weekly collection without decreasing the level of recovery.

SECTION 3
ANALYSIS OF CURBSIDE RECYCLING

3.1 SCENARIOS EVALUATED

Four household solid waste management scenarios containing the proposed expanded drop-off recycling program and/or curbside recycling were evaluated:

1. Base Case Drop-Off Recycling Scenario. Includes the proposed drop-off recycling program with 100 drop-off locations, the proposed green waste collection program and twice-per-week refuse collection.

2. Alternative 1 Curbside Recycling Scenario. Includes biweekly (i.e., every other week) curbside recycling (in place of drop-off recycling), the proposed green waste collection program and twice-per-week refuse collection.

3. Second Drop-Off Recycling Scenario. The same as Scenario 1 except for refuse collection only once per week instead of twice per week.

4. Alternative 2 Curbside Recycling Scenario. Includes the proposed drop-off recycling program (100 drop-off locations) along with once-per-week curbside recycling, once-per-week refuse collection and the proposed green waste collection program.

The distinguishing elements of each scenario may be summarized as follows:

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Drop-Off Recycling	100 Sites	None	100 Sites	100 Sites
Curbside Recycling	None	Once/2 Wks.	None	Once/Wk.
Refuse/Rubbish	Twice/Wk.	Twice/Wk.	Once/Wk.	Once/Wk.
Green Waste	Once/2 Wks.	Once/2 Wks.	Once/2 Wks.	Once/2 Wks

Scenarios 1 and 3 include drop-off recycling only. It is assumed that an additional 35 drop-off recycling sites will be added to the 65 sites currently in use at schools and other locations for collecting primarily single-family generated materials. In addition, separate collection of green waste for composting would be used to reduce green waste collected as refuse by an estimated 50 percent. Twice-per-week collection of refuse would continue in Scenario 1 but once-per-week refuse collection would occur with Scenario 3.

Scenarios 2 and 4 both include curbside recycling. Scenario 2 substitutes curbside recycling for drop-off recycling for the single-family households whereas Scenario 4 includes both. The other differences in these two scenarios are in the refuse and recyclables collection frequencies, as noted above. For both scenarios, different curbside recycling options were examined in the designated automated and manual refuse collection areas, respectively. The analysis assumed collection of recyclables in the automated areas using the same type of automated packer trucks used for refuse collection. In the areas of the city slated for manual refuse collection, it was assumed that recyclables would be collected in traditional recycling trucks. Materials to be collected in the automated and manual areas are as follows:

Automated Areas	**Manual Areas**
Old Newspapers (ONP)	Old Newspapers (ONP)
High Grade Paper	High Grade Paper
Old Corrugated Containers (OCC)	
PET Beverage Bottles	PET Beverage Bottles
HDPE Beverage & Other Bottles	HDPE Beverage & Other Bottles
Aluminum Cans	Aluminum Cans
Steel/Tin Cans	Steel/Tin Cans
Glass Containers	Glass Containers

In the automated collection areas, the curbside recycling analysis included collection of commingled household recyclables from 64-gallon carts. The materials would be completely commingled in the single-compartment automated trucks and would require separation at a materials recovery facility (MRF).

In the manual collection areas, the analysis included collection of recyclables from 18-gallon bins. Collection would include the same materials as in the automated areas except for OCC—judged as too bulky to be included in the bins. It was assumed that ONP and high grade paper would be placed in paper sacks or bundled and placed on top of the containers, which would be commingled in a single 18-gallon bin per household. A one-person crew would place the paper and containers in separate sections of a side-loading automated lift hopper. The paper grades and containers would be dumped from the hopper into separate compartments of a two-compartment truck with a moveable divider wall/panel. The separation of the paper from the containers would reduce the processing required at the MRF over that required for the completely commingled materials from the automated areas.

3.2 METHODOLOGY

3.2.1 Quantities Collected

An initial effort in the analysis was determining the quantities of household waste that would be collected through each program. For both the automated and manual collection area evaluations, a city-wide average of total single-family refuse generation was used.[8] For Scenarios 1 and 3, this quantity was divided between the proposed drop-off program, the proposed green waste collection program and refuse collection. For Scenario 2, quantities were estimated for the proposed curbside recycling programs, the proposed green waste program and refuse collection. For Scenario 4, single-family generation was divided still further between the proposed drop-off program, the proposed curbside recycling programs, the green waste program and refuse collection.

The estimated drop-off quantity in Scenarios 1 and 3 was based on assuming that each of the planned additional 35 drop-off centers would collect only half as much as the existing ones. The quantity from the existing sites was added to this estimate from the new sites to estimate a total drop-off quantity for these scenarios. When including both drop-off recycling and curbside recycling (Scenario 4), it was assumed that drop-off quantities—for materials also collected through the curbside programs—would drop by 50 percent.

The quantity of recyclables collected in each curbside recycling program was based on multiplying household participation estimates by estimated capture rates (i.e., the percentage of each material that a participating household will separate for recycling). It was estimated that participation rates would vary substantially in the automated versus manual areas because of the differences in collection methods and materials included. As noted in the previous section, the use of carts instead of the much smaller bins for storing household recyclables appears to result in higher levels of participation and recovery. Evidence indicates that adding more materials to a curbside recycling program increases participation as well.[9] For these reasons, a 90 percent household participation in curbside recycling was assumed for the automated areas for both weekly and biweekly collection. For the manual areas, 75 percent of households were assumed to participate with weekly collection and 70 percent with biweekly collection . Capture rates for each material were based on Franklin Associates data from other studies (including the American Plastics Council study referenced in footnote 8) and were assumed the same for the automated and manual areas.

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[8] Based on quantity data provided by the City and County of Honolulu Refuse Division.

[9] American Plastics Council. How to Collect Plastics for Recycling: Lessons from the Model Cities Demonstration Program. 1995.

While we have used 90 percent participation rate for automated collection areas and 75 percent for manual, we recognize that in areas establishing new curbside programs, such as Honolulu, it will take some time to achieve these participation rates. The time and effort cannot be estimated because they depend on the level of education undertaken by the City and County and the enforcement of program requirements with the householder. The City will need to budget funds for these activities, as it would with any new program. The cost of the program on a per ton basis may be higher initially than shown in our estimates, but is expected to decrease as the participation rates raise to the levels indicated.

3.2.2 Program Costs

Single-family household solid waste management system costs (excluding those for bulky wastes) were developed for each scenario in both the automated and manual collection areas. This required estimates for collection, transfer and disposal of refuse, collection and processing of recyclables, recyclables revenues, and collection and composting of green wastes. Net costs for the drop-off program and the green waste program were provided for use in the analysis.

The four scenarios all differed with respect to refuse collection—either in quantities collected or in collection frequency. In estimating refuse collection costs under each scenario, it was necessary to first estimate the number of households that would be served by an average collection crew in both the automated and manual areas. The data and methods used in estimating changes in the number of households per collection route for the once-per-week refuse collection analysis were used here as well. It was assumed that collection crews would continue to be paid for 10-hour days in the automated areas and 8-hour days in the manual areas; six-day collection weeks were assumed as well. It was also assumed that the manual collection crews would each remain limited to collection of 24,000 pounds per day.

The costs found in the once-per-week refuse collection analysis were used to estimate refuse collection costs under Scenario 3. (This reflected the small differences in collected refuse in that analysis and Scenario 3.) For the automated areas, the dollars per ton savings with once-per-week refuse collection—as determined previously—were subtracted from twice-per-week refuse collection costs estimated for Scenario 1; the result was the estimate of once-per-week refuse collection costs in the automated areas under Scenario 3. For the manual areas, the same dollars per ton cost for refuse collection determined in the once-per-week analysis was used for Scenario 3. This reflected the

24,000 pounds per day collection limit, which should be achieved in both cases.

Disposal of refuse was assumed to occur at the H-POWER waste-to-energy facility. The same *total* cost to the City to dispose of refuse at H-POWER was assumed regardless of the refuse quantity. Thus, no net savings from removing recyclables from H-POWER was factored into the analysis and the disposal cost allocated to each household remained the same under both scenarios.

Much of the collected refuse on Oahu is routed through transfer stations and taken to H-POWER in larger vehicles than those used for collection. The refuse transfer costs used for Scenarios 1 and 3 were provided by the City. The City's estimate of a 10 percent increase in dollars per ton costs for refuse transfer with Scenario 2 was also used. A slightly higher cost per ton figure was estimated for refuse transfer with Scenario 4.

Estimating the costs of collecting recyclables placed at the curb also required determining the number of households that could be served by a collection crew. In the automated areas, data from the once-per-week refuse collection analysis were used in estimating curbside recycling routes since the collection methods would be the same. In the manual areas, data from previous Franklin Associates' studies were adjusted for estimated quantities collected and neighborhood characteristics specific to Oahu. Collection crews were assumed to work 10-hour and 8-hour days, respectively, in the automated and manual areas.

Off-route times estimated for transporting recyclables to a MRF were increased from off-route times used in the once-per-week refuse collection analysis. This reflected the expectation that only one MRF would be built to handle collected recyclables and that collection trucks would haul directly to the MRF instead of a transfer station. Accordingly, average haul distances for the collection trucks would be significantly greater, on average, than those experienced for refuse. In some areas, the extra haul distance would be much greater but would probably not justify the added processing cost with a second MRF. For estimating purposes, the MRF was assumed to be located in the Sand Island area.

Since the City currently has a contract for $0.001 per pound of paper and $0.006 per pound of containers collected from the drop-off system, these net revenues (after

processing) were assumed for curbside recyclables from the manual collection areas.[10] For the automated areas, processing costs were included for the separation of paper from containers—a sorting step not required in the manual areas where the paper and containers would be collected in separate truck compartments.

3.3 ANALYSIS RESULTS

3.3.1 Quantities Collected

A comparison of the management of solid wastes (excluding bulky materials) from an average single-family household on Oahu under Scenarios 1 through 4 is shown in Table 1. With the expanded drop-off recycling program proposed under Scenarios 1 and 3, recovery from drop-offs was projected at about 1.9 pounds of recyclables per household per week—or 2.8 percent of generation. This is about 27 percent above the recovery reported from the existing drop-off program.

The disposition of household wastes with the proposed curbside recycling in Scenario 2 would vary significantly between the automated and manual collection areas. As shown in Table 1, substantially more recovery was projected from the automated areas than from the manual areas. This reflects the higher household participation in curbside recycling expected with automated collection plus the collection of OCC in the automated areas but not the manual areas. Curbside recovery in the automated areas is shown at about 9.3 pounds per household per week (13.8 percent of generation) versus just over 5.4 pounds per household (8.1 percent of generation) in the manual areas.

With separate collection of recyclables through both curbside recycling and drop-off recycling (Scenario 4), total recovery would be maximized. From Table 1, recovery in the automated areas is shown at over 9.6 lbs. per household per week (14.3% of generation); corresponding figures for the manual areas are 6.6 pounds and 9.8% of generation. Since the curbside and drop-off programs would be competing for materials in Scenario 4 neither program was projected, by itself, to collect as much as when acting alone.

The proposed green waste collection program, included under all four scenarios, adds about 9.9 pounds of projected recovery. This equates to about 14.7 percent of household generation—a higher recovery level than shown for any of the proposed curbside recycling programs.

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[10] It should be noted that these net revenues may not reflect current end-user market prices and actual processing costs for commingled recyclables collected through curbside recycling.

Table 1
Comparison of Household Solid Waste Management
Under Scenarios 1, 2, 3 and 4 (1)

	Breakdown With Proposed Drop-Off Sites Under Scenarios 1 & 3		Breakdown With Proposed Curbside Recycling Under Scenario 2				Breakdown With *Proposed Curbside + Drop-Off Recycling* Under Scenario 4			
	City-Wide		Automated Areas		Manual Areas		Automated Areas		Manual Areas	
	Quantity (lb/HH/wk)	Percent	Quantity (lb/HH/wk)	Percent	Quantity (lb/HH/wk)	Percent	Quantity (lb/HH/wk)	Percent	Quantity (lb/HH/wk)	Percent
Refuse Collected for Disposal	55.55	82.53	48.15	71.53	52.01	77.27	47.81	71.03	50.85	75.55
Green Waste Collected for Composting (2)	9.87	14.66	9.87	14.66	9.87	14.66	9.87	14.66	9.87	14.66
Materials Collected for Recycling (3)	1.89	2.81	9.29	13.80	5.43	8.07	9.63	14.31	6.59	9.79
Totals	67.31	100.00	67.31	100.00	67.31	100.00	67.31	100.00	67.31	100.00

(1) Breakdown for waste collected from an average single-family household under Scenarios 1, 2, 3 and 4. Breakdown for Scenarios 1 and 3 is the same city-wide. Breakdowns for Scenarios 2 and 4 are different in the automated and manual areas because of differences in materials included and participation in the curbside programs.
(2) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(3) Assumes current drop-off program will be increased from 65 to 100 sites with each new site collecting half the amount of material collected in each existing site. For materials included in Scenario 4 curbside recycling, quantities collected through the drop-off sites assumed to be reduced by half. Other materials in the drop-off program assumed at the same collection levels as before.

Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 2 contains the estimates of disposition under the four scenarios aggregated for all of Oahu. Recovery in the automated and manual areas are combined for each scenario. Total recovery under Scenarios 2 and 4 is shown at over 39,000 and over 41,000 tons per year, respectively, versus about 8,600 tons under Scenarios 1 and 3. City-wide recovery through curbside recycling alone would be 12.8 percent of household generation versus 2.8 percent for recovery through drop-offs alone. With drop-off recycling and curbside recycling together, recovery of 13.5 percent of household generation is shown.

Although not reflected in Table 2, metal cans from the residential waste collected for disposal at H-POWER are recovered for recycling. Under Scenarios 1 and 3, approximately 5,200 tons of metal cans would be received at H-POWER and, presumably, recovered. Thus, total recovery for recycling under these scenarios would be estimated at 13,800 tons or 4.5 percent of household generation.

3.3.2 Program Costs

3.3.2.1 Automated Collection Areas

Estimated single-family solid waste management costs in the automated areas under Scenario 1 are shown in Table 3. The total cost for an average household generating 1.75 tons per year (excluding bulky wastes) is shown at $18.80 per month or about $129 per ton. This cost includes a program to collect about half of the green waste for composting and a drop-off recycling program expanded from 65 to 100 sites.

Corresponding household costs under Scenario 2, which substitutes curbside recycling for drop-off recycling, are estimated in Table 4. The total cost for an average household is shown at $20.00 per month ($137 per ton). Thus, substituting curbside recycling for the proposed drop-off program would increase household waste management costs in the automated areas an estimated $1.20 per household per month or 6.4 percent.

Household costs in the automated areas under Scenario 3, which differs from Scenario 1 in that refuse collection is once per week instead of twice, are estimated in Table 5. The total household cost is shown at $17.76 per month or about $122 per ton. This indicates a savings of $1.04 per household per month by switching from twice to once-per-week refuse collection.

Table 2
Comparison of City-Wide Household Solid Waste Management Under Scenarios 1, 2, 3, and 4 (1)

	Breakdown With Proposed Drop-Off Sites Under Scenarios 1 & 3		Breakdown With Proposed Curbside Recycling Under Scenario 2		Breakdown With Proposed Curbside Recycling Under Scenario 4	
	City-Wide		City-Wide		City-Wide	
	Quantity (tons/year)	Percent	Quantity (tons/year)	Percent	Quantity (tons/year)	Percent
Refuse Collected for Disposal	252,319	82.53	221,739	72.53	219,550	71.81
Green Waste Collected for Composting	44,832	14.66	44,832	14.66	44,832	14.66
Materials Collected for Recycling	8,585	2.81	39,165	12.81	41,354	13.53
Totals	305,735	100.00	305,735	100.00	305,735	100.00

(1) Breakdown for waste collected from 174,700 single-family households under Scenarios 1, 2, 3, and 4: 144,491 households in automated collection areas and 30,209 households in manual collection areas at full implementation of automated collection.

Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 3
Scenario 1
Household Solid Waste Management Costs
In Automated Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.444	42.94	62.02	5.17
Refuse Transfer	1.444	36.00	51.99	4.33
Refuse Disposed at H-POWER	1.444	44.00	63.55	5.30
Refuse Disposed Subtotal	1.444	122.94	177.56	14.80
Green Waste Program (3)	0.257	170.00	43.63	3.64
Drop-off Recycling (4)	0.049	90.20	4.43	0.37
Totals	1.750	128.92	225.62	18.80

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 55.55 pounds collected for disposal, 9.87 pounds collected in green waste program and 1.89 pounds in drop-off recycling facilities.
(2) Estimated costs assume twice per week collection of refuse.
(3) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(4) Assumes current drop-off program will be increased from 65 to 100 sites with each new site collecting half the amount of material collected in each existing site.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 4
Scenario 2
Household Solid Waste Management Costs
In Automated Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.252	46.62	58.36	4.86
Refuse Transfer (3)	1.252	39.60	49.58	4.13
Refuse Disposed at H-POWER (4)	1.252	50.76	63.55	5.30
Refuse Disposed Subtotal	1.252	136.98	171.49	14.29
Green Waste Program (5)	0.257	170.00	43.63	3.64
Curbside Recyclables Collection (6)	0.242	95.19	22.99	1.92
Curbside Recyclables Processing (7)	0.242	12.50	3.02	0.25
Curbside Recyclables Recovery Subtotal	0.242	107.69	26.01	2.17
Curbside Recyclables Revenues (8)	0.242	(4.42)	(1.07)	(0.09)
Net Curbside Recycling Costs	0.242	103.27	24.94	2.08
Total Household Solid Waste & Costs	1.750	137.17	240.06	20.00

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 48.15 pounds collected for disposal, 9.87 pounds collected in green waste program and 9.29 pounds in curbside recycling program.
(2) Estimated costs assume twice per week collection of refuse.
(3) Assumes a 10 percent increase in dollars/ton transfer costs from that indicated by the City for Scenarios 1 and 3.
(4) Assumes no savings (i.e., no difference in total costs) at H-POWER from removing recyclables.
(5) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(6) Estimated costs assume biweekly collection of recyclables.
(7) Includes only the added cost of sorting paper from containers. Other processing costs are assumed to be deducted from the prices shown for the recovered materials.
(8) Revenues are net of processing costs other than those for sorting paper from containers.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 5
Scenario 3
Household Solid Waste Management Costs
In Automated Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.444	34.29	49.53	4.13
Refuse Transfer	1.444	36.00	51.99	4.33
Refuse Disposed at H-POWER	1.444	44.00	63.55	5.30
Refuse Disposed Subtotal	1.444	114.29	165.07	13.76
Green Waste Program (3)	0.257	170.00	43.63	3.64
Drop-off Recycling (4)	0.049	90.20	4.43	0.37
Totals	1.750	121.78	213.13	17.76

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 55.55 pounds collected for disposal, 9.87 pounds collected in green waste program and 1.89 pounds in drop-off recycling facilities.
(2) Estimated costs assume once per week collection of refuse.
(3) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(4) Assumes current drop-off program will be increased from 65 to 100 sites with each new site collecting half the amount of material collected in each existing site.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

Scenario 4 demonstrates the estimated cost of adding once-per-week curbside recycling while maintaining the proposed drop-off program. Household costs in the automated areas are shown in Table 6 at $19.63 per month or about $135 per ton. The cost of adding once-per-week curbside recycling while otherwise keeping the system proposed in Scenario 3 is thus estimated at $1.87 per household per month or 10.5 percent.

Table 6
Scenario 4
Household Solid Waste Management Costs
In Automated Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.243	37.16	46.19	3.85
Refuse Transfer (3)	1.243	39.86	49.55	4.13
Refuse Disposed at H-POWER (4)	1.243	51.12	63.55	5.30
Refuse Disposed Subtotal	1.243	128.14	159.29	13.27
Green Waste Program (5)	0.257	170.00	43.63	3.64
Drop-Off Recycling (6)	0.026	90.20	2.35	0.20
Curbside Recyclables Collection (7)	0.224	126.99	28.49	2.37
Curbside Recyclables Processing (8)	0.224	12.50	2.80	0.23
Curbside Recyclables Recovery Subtotal	0.224	139.49	31.30	2.61
Curbside Recyclables Revenues (9)	0.224	(4.42)	(0.99)	(0.08)
Net Curbside Recycling Costs	0.224	135.07	30.31	2.53
Total Household Solid Waste & Costs	1.750	134.61	235.57	19.63

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 47.81 pounds collected for disposal, 9.87 pounds collected in green waste program, 8.63 pounds collected in curbside recycling program and 1.00 pounds collected in drop-off recycling program.
(2) Estimated costs assume once per week collection of refuse.
(3) Assumes a small increase in dollars/ton transfer costs from that used for Scenario 2. This reflects slightly less refuse disposed in Scenario 4 than in Scenario 2.
(4) Assumes no savings (i.e., no difference in total costs) at H-POWER from removing recyclables.
(5) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(6) Assumes proposed drop-off program of 100 sites.
(7) Estimated costs assume once per week collection of recyclables.
(8) Includes only the added cost of sorting paper from containers. Other processing costs are assumed to be deducted from the prices shown for the recovered materials.
(9) Revenues are net of processing costs other than those for sorting paper from containers.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

3.3.2.2 Manual Collection Areas

Estimated single-family solid waste management costs in the manual areas under Scenario 1 are shown in Table 7. The total cost for an average household with 1.75 tons per year is shown at $21.30 per month or $146 per ton. The higher Scenario 1 cost for the manual areas versus the automated areas is due to much higher refuse collection costs in the manual areas.

Household costs in the manual areas under Scenario 2 are estimated in Table 8. The total cost for an average household is shown at $22.15 per month or about $152 per ton. Thus, the increase in household costs in the manual areas with curbside recycling in place of the proposed drop-off recycling is $0.85 per household per month or 4.0 percent.

Costs in the manual areas under Scenario 3 are shown at $18.84 per household per month or $129 per ton (Table 9). This reflects a savings of $2.46 per household per month by switching from twice to once-per-week refuse collection.

Costs in the manual areas under Scenario 4 are shown at $19.84 per household per month or $136 per ton (Table 10). This equates to an increase of $1.00 per household per month (or 5.3 percent) to add once-per-week curbside recycling to the system proposed in Scenario 3.

3.3.2.3 Added Costs of Curbside Recycling

Comparisons of the cost *increases* per household when adding curbside recycling in the automated and manual areas are illustrated in Figures 1 and 2. Figure 1 shows the monthly cost increases in the automated and manual areas when substituting biweekly curbside recycling (Scenario 2) for the proposed drop-off recycling in Scenario 1. Figure 2 shows the cost increases in these areas when adding weekly curbside recycling (Scenario 4) to the Scenario 3 system that includes the proposed drop-off recycling program.

The much lower cost increases shown (with curbside recycling) in the manual areas is due in large part to the much lower quantity of recyclables collected and lower participation rates. Seventy percent of manual area households served were projected to set recyclables at the curb with biweekly collection and 75 percent were projected to do so with weekly collection. This compared to 90 percent of automated area households projected to participate with either weekly or biweekly collection. With fewer collection stops and lower quantities of recyclables collected at each household, as well, recyclables collection

costs per household served were estimated to be significantly lower in the manual areas. Also, the added processing cost with automated collection to separate paper from containers would not be needed with manual collection, which assumed paper and containers in separate compartments of the collection truck.

Table 7
Scenario 1
Household Solid Waste Management Costs
In Manual Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.444	76.64	110.69	9.22
Refuse Transfer	1.444	36.00	51.99	4.33
Refuse Disposed at H-POWER	1.444	44.00	63.55	5.30
Refuse Disposed Subtotal	1.444	156.64	226.24	18.85
Green Waste Program (3)	0.257	97.00	24.89	2.07
Drop-off Recycling (4)	0.049	90.2	4.43	0.37
Totals	1.750	146.03	255.56	21.30

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 55.55 pounds collected for disposal, 9.87 pounds collected in green waste program and 1.89 pounds in drop-off recycling facilities.
(2) Estimated costs assume twice per week collection of refuse.
(3) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(4) Assumes current drop-off program will be increased from 65 to 100 sites with each new site collecting half the amount of material collected in each existing site.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 8
Scenario 2
Household Solid Waste Management Costs
In Manual Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.352	79.78	107.88	8.99
Refuse Transfer (3)	1.352	39.60	53.55	4.46
Refuse Disposed at H-POWER (4)	1.352	46.99	63.55	5.30
Refuse Disposed Subtotal	1.352	166.37	224.98	18.75
Green Waste Program (5)	0.257	97.00	24.89	2.07
Curbside Recyclables Collection (6)	0.141	117.94	16.65	1.39
Curbside Recyclables Processing (7)	0.141	0.00	0.00	0.00
Curbside Recyclables Recovery Subtotal	0.141	117.94	16.65	1.39
Curbside Recyclables Revenues (8)	0.141	(5.20)	(0.73)	(0.06)
Net Curbside Recycling Costs	0.141	112.74	15.92	1.33
Total Household Solid Waste & Costs	1.750	151.87	265.79	22.15

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 52.01 pounds collected for disposal, 9.87 pounds collected in green waste program and 5.43 pounds in curbside recycling program.
(2) Estimated costs assume twice per week collection of refuse.
(3) Assumes a 10 percent increase in dollars/ton transfer costs from that indicated by the City for Scenarios 1 and 3.
(4) Assumes no savings at H-POWER from removing recyclables.
(5) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(6) Estimated costs assume biweekly collection of recyclables.
(7) No processing costs are shown since they are assumed as deducted from the prices shown for the recovered materials.
(8) Revenues are net of processing costs.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 9
Scenario 3
Household Solid Waste Management Costs
In Manual Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.444	56.24	81.23	6.77
Refuse Transfer	1.444	36.00	51.99	4.33
Refuse Disposed at H-POWER	1.444	44.00	63.55	5.30
Refuse Disposed Subtotal	1.444	136.24	196.77	16.40
Green Waste Program (3)	0.257	97.00	24.89	2.07
Drop-off Recycling (4)	0.049	90.2	4.43	0.37
Totals	1.750	129.19	226.10	18.84

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 55.55 pounds collected for disposal, 9.87 pounds collected in green waste program and 1.89 pounds in drop-off recycling facilities.
(2) Estimated costs assume once per week collection of refuse. Costs reflect 24,000 pounds per day limit for collection crew.
(3) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(4) Assumes current drop-off program will be increased from 65 to 100 sites with each new site collecting half the amount of material collected in each existing site.

Note: Numbers may not add due to rounding.

Source: Franklin Associates

Table 10
Scenario 4
Household Solid Waste Management Costs
In Manual Collection Areas (1)

	Household Quantity (Tons/Year)	Household Cost ($/Ton)	($/Year)	($/Month)
Refuse Collection & Transport (2)	1.322	56.24	74.35	6.20
Refuse Transfer (3)	1.322	39.86	52.70	4.39
Refuse Disposed at H-POWER (4)	1.322	48.07	63.55	5.30
Refuse Disposed Subtotal	1.322	144.17	190.60	15.88
Green Waste Program (5)	0.257	97.00	24.89	2.07
Drop-Off Recycling (6)	0.031	90.20	2.81	0.23
Curbside Recyclables Collection (7)	0.140	146.41	20.52	1.71
Curbside Recyclables Processing (8)	0.140	0.00	0.00	0.00
Curbside Recyclables Recovery Subtotal	0.140	146.41	20.52	1.71
Curbside Recyclables Revenues (9)	0.140	(5.20)	(0.73)	(0.06)
Net Curbside Recycling Costs	0.140	141.21	19.79	1.65
Total Household Solid Waste & Costs	1.750	136.05	238.10	19.84

(1) For an average single-family household generating 67.31 pounds/week of MSW (after bulky durables); 50.85 pounds collected for disposal, 9.87 pounds collected in green waste program, 5.39 pounds collected in curbside recycling program and 1.20 pounds collected in drop-off recycling program.
(2) Estimated costs assume once per week collection of refuse. Costs reflect 24,000 pounds per day limit for collection crew.
(3) Assumes a small increase in dollars/ton transfer costs from that used for Scenario 2. This reflects slightly less refuse disposed in Scenario 4 than in Scenario 2.
(4) Assumes no savings at H-POWER from removing recyclables.
(5) Assumes separate collection of approximately 50 percent of green waste, which was assumed at 15 percent of current refuse collection.
(6) Assumes proposed drop-off program of 100 sites.
(7) Estimated costs assume once per week collection of recyclables.
(8) No processing costs are shown since they are assumed as deducted from the prices shown for the recovered materials.
(9) Revenues are net of processing costs.
Note: Numbers may not add due to rounding.

Source: Franklin Associates

Figure 1. Added Cost For Biweekly Curbside Recycling (Scenario 2)

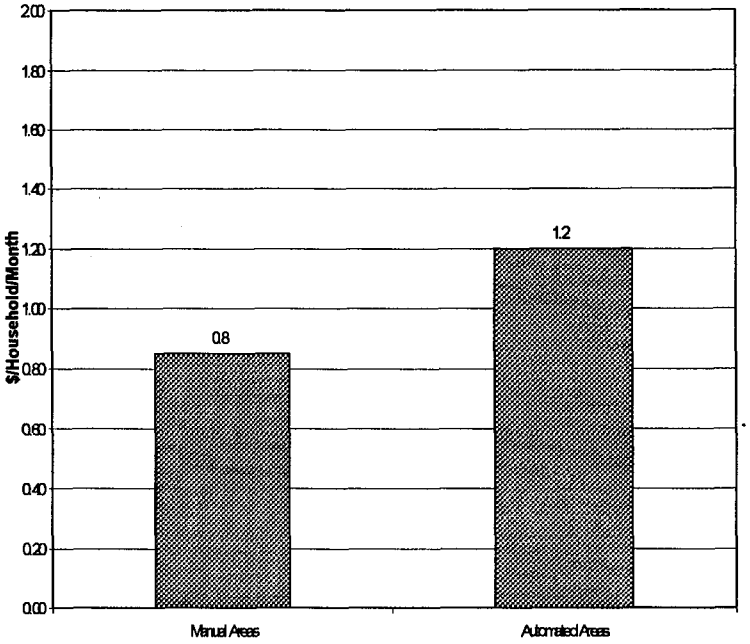
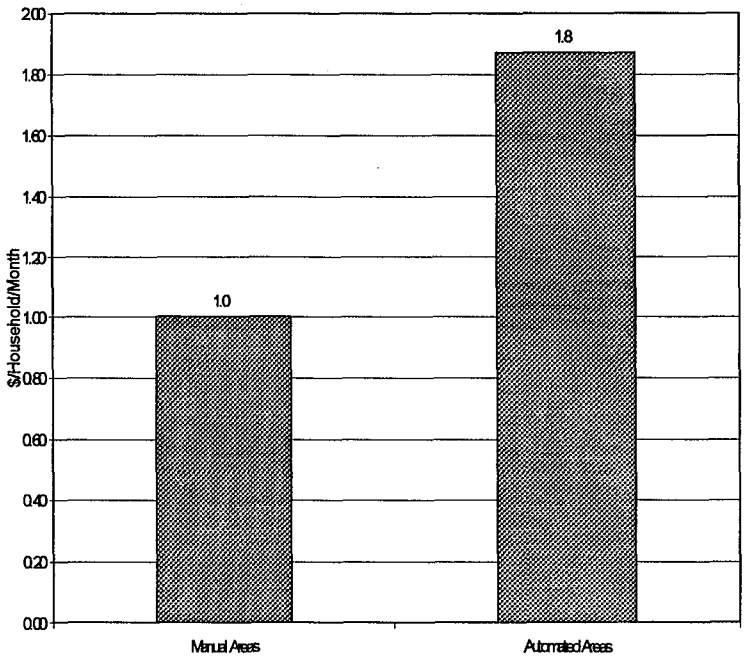


Figure 2. Added Cost For Weekly Curbside Recycling (Scenario 4)



The added household costs with curbside recycling are shown as significantly higher with weekly recyclables collection (Scenario 4) than with biweekly collection (Scenario 2). However, the increase with weekly collection is shown to be much greater in the automated areas than in the manual areas. This can be at least partly attributed to the 24,000 pounds per day limit on refuse collection by manual crews. This limit was estimated to be met in both Scenarios 3 and 4, which resulted in the same cost per ton for refuse collection in each. In the automated areas, a higher cost per ton for refuse collection was estimated for Scenario 4 than Scenario 3 due to lesser quantities collected per household in Scenario 4. Had this been true in the manual areas, the added household cost for weekly curbside recycling—i.e., the difference in total costs between Scenarios 3 and 4—in the manual areas would have been greater than the $1.00 per month shown.

3.3.2.4 Total City Costs

A comparison of estimated total city costs with each of the four scenarios examined is found in Table 11. The highest cost scenario shown is Scenario 2 at $42.7 million dollars per year and a weighted average cost per household of $20.37 per month. The lowest cost scenario (Scenario 3) is shown at $37.6 million dollars per year and $17.95 per household per month—a savings of $5.1 million dollars or $2.42 per household per month from Scenario 2. The lower costs with Scenario 3 can be attributed to once-per-week instead of twice-per-week refuse collection and drop-off recycling instead of curbside recycling.

Of the two curbside recycling scenarios (Scenarios 2 and 4), Scenario 4 is shown as the least expensive even with weekly instead of biweekly recyclables collection. The total cost of Scenario 4 was estimated at $1.5 million less than Scenario 2 or $0.70 per household monthly. The difference here also reflects the savings with once- instead of twice-per-week refuse collection.

The curbside recycling scenarios would require substantial initial capital investments to implement. Total capital costs to implement curbside recycling city-wide were estimated at nearly $17 million under Scenario 2 and about $15.5 million under Scenario 4. (The lower cost under Scenario 4 reflects the need for fewer new automated collection vehicles; changing to once-per-week refuse collection would free some of the automated refuse trucks for use in collecting recyclables.) About $5 million of the capital requirements were estimated for a new MRF to process the collected recyclables. The remaining up-front costs would be for trucks, carts and bins. The major cost item would be the proposed 65-gallon carts for the automated areas—estimated at nearly $8.4 million.

Table 11
City-Wide Household Solid Waste Management Costs
Under Scenarios 1, 2, 3, and 4 (1)

	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Costs Per Household ($/Month)	City-Wide Annual Costs ($1,000)	Costs Per Household ($/Month)	City-Wide Annual Costs ($1,000)	Costs Per Household ($/Month)	City-Wide Annual Costs ($1,000)	Costs Per Household ($/Month)	City-Wide Annual Costs ($1,000)
Automated Collection Areas	18.80	32,597	20.00	34,678	17.76	30,794	19.63	34,036
Manual Collection Areas	21.30	7,721	22.15	8,030	18.84	6,830	19.84	7,192
Totals (2)	19.23	40,319	20.37	42,707	17.95	37,624	19.67	41,228

(1) Estimates based on costs per single-family household from Tables 3 through 10 multiplied by total households served: 144,491 households in automated collection areas and 30,209 households in manual collection areas.
(2) Total cost per household figures are weighted averages for the entire city calculated by dividing total city-wide costs by the 174,700 single-family households served.
Note: Numbers may not add due to rounding.

Source Franklin Associates

3.3.2.5 Cost Comparisons

A comparison of added costs estimated for curbside recycling on Oahu with those estimated or reported for other U.S. locations is shown in Table 12. In addition to estimated costs on Oahu, the table includes: a 40 communities average estimate, an estimate for a hypothetical 250,000 population base, and costs reported for programs in Des Moines, Iowa, and Los Angeles, California. The average shown for the 40 communities was based on costs from a recent survey.[11] These costs were reported to include *no* credit for avoided disposal costs and were, therefore, adjusted down in Table 8 to reflect a savings judged as typical (see table footnote).

Two sets of reported costs are shown for Los Angeles, which demonstrates the difficulty in obtaining reliable figures. The differences in the reported costs are substantial, which may suggest that the higher cost figures are also absent any savings from avoided refuse disposal.

For Oahu, added costs were projected for:

- biweekly curbside recycling (Scenario 2) substituted for drop-off recycling (Scenario 1), and
- weekly curbside recycling plus drop-off recycling (Scenario 4) substituted for drop-off recycling only (Scenario 3).

The added costs projected for biweekly curbside recycling on Oahu are on the low side of those shown in Table 12. On a weighted average basis, the added cost is shown at $61 per ton of recyclables recovered or $1.14 per household per month. Since collection is usually the major cost element in a curbside recycling program, the savings achieved by reducing on-route time through biweekly collection can be substantial. The other curbside recycling costs shown in Table 12 generally reflect weekly collection of recyclables.

The added costs shown for weekly curbside recycling on Oahu vary a great deal between the automated and manual areas, as noted earlier. However, on a weighted average basis, the added cost is shown at $98 per ton of recyclables recovered or $1.72 per household per month. This appears to be within the range of typical costs for curbside recycling found in other locations.

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[11] Stevens, Barbara J. Recycling and Yard Debris Collection: State of The Industry. Resource Recycling. September 1998.

Table 12
Curbside Recycling Cost Comparisons

Area/Community:	Estimated/Reported Cost (1) ($/Ton Recovery)	($/HH/Mo)
Average for 40 communities (2)	87	1.67
Estimated for 250,000 population (3)	126	2.05
Des Moines, Iowa (4)		
Current with Container Deposit Law	126	1.80
Estimate without Deposit Law	77	1.34
Los Angeles, California		
Manual Collection from Bin (5)		1.21
Automated Collection from Cart (5)		0.74
Manual Collection from Bin (6)	199	2.08
Automated Collection from Cart (6)	< 90	2.08
City & County of Honolulu (7)		
Manual Collection from Bin	72	0.85
Automated Collection from Cart	60	1.20
Weighted Average	61	1.14
City & County of Honolulu (8)		
Manual Collection from Bin	86	1.00
Automated Collection from Cart	100	1.87
Weighted Average	98	1.72

(1) Reflects added cost for curbside recycling. $/Ton Recovery column is designed to show added cost divided by curbside recovered tons.
(2) Adjusted from $127/ton and $2.40/household reported in September 1998 Resource Recycling article. Adjusted down to account for savings in refuse collection/disposal costs judged typical in U.S.
(3) From Franklin Associates' SWM At The Crossroads, December 1997. Assumes once/week manual collection from bins in typical communtiy.
(4) From Des Moines Metro Waste Authority for curbside recycling in 1997 with container deposit law; Franklin Associates' estimate without the deposit law. For once/week collection.
(5) From July 1997 World Wastes article. For once/week collection.
(6) From December 1997 Resource Recycling article. Not clear whether avoided costs of refuse collection and disposal are included. For once/week collection.
(7) Estimated for biweekly curbside collection of recyclables (Scenario 2) as replacement for drop-off recycling (Scenario 1).
(8) Estimated for weekly curbside collection of recyclables plus expanded drop-off recycling (Scenario 4) compared with expanded drop-off recycling only (Scenario 3).

Source: Franklin Associates

Certain recyclables, including glass containers and ONP, appear to be generated at a lower rate on Oahu than in most other large metropolitan areas.[12] This reduced the estimated quantities collected in the manual areas below that typically observed in other communities and led to lower household cost estimates in the manual areas. Collection of OCC and a higher participation rate resulted in more typical curbside recycling quantity and cost estimates in the automated areas.

First-hand observation suggests that single-family homes on Oahu are spaced closer together on average than in many locations on the mainland. This reduces on-route collection time, which lowers curbside recycling costs in both the automated and manual areas.

Finally, it should be noted that the cost of curbside recycling is dependent upon the prices that can be obtained for recovered materials. As noted previously, net prices currently paid (by contract) for materials delivered from the City's drop-off program to a local processor were used in the cost analysis. These may not accurately reflect current market conditions and the cost of processing materials from the proposed curbside recycling programs. They may, in fact, have resulted in a lower cost estimate for curbside recycling on Oahu than could be justified by current *end-user* market prices. Processing costs at MRFs are typically $50 per ton or higher.

3.3.3 Other Considerations

In addition to costs, other factors can affect a decision regarding whether a curbside recycling program will be implemented. These include the following:

- Legislative/regulatory requirements
- Public and political goals/objectives
- Technical/compatibility constraints
- Materials markets volatility
- Implementation requirements

Some communities implement curbside recycling to comply with mandated recycling levels or programs. Other communities do so in response to expressed public/political wishes. In these cases, the costs of adding curbside recycling may be of secondary importance.

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[12] Based on results from three sampling periods conducted for Oahu Waste Stream Composition Study compared with national estimates developed by Franklin Associates.

Technical factors can also be important in the decision. A consideration in Honolulu is the room required at each household to store a recyclables container along with those needed for refuse and green waste. In the automated areas, a typical household would have at least three carts—one for refuse, one for green waste and one for recyclables. Some households would also have a second refuse cart—particularly if once-per-week refuse collection were implemented.

The volatility of recycling markets is another concern that affects the net cost of recycling and can force changes in established programs. For example, if the market for a material currently collected should disappear or the price falls enough, collection of the material might need to be halted. From Oahu, materials must be shipped to overseas markets, which makes recycling programs even more vulnerable to market changes.

Implementing curbside recycling would require new plant and equipment and added labor. In the automated collection areas, additional trucks like those used for refuse collection would be needed along with a cart for each household to store their recyclables. In the manual collection areas, traditional recycling trucks with side-loading hoppers would be needed along with a storage bin for each household. A materials recovery facility (MRF) would have to be established to process the collected recyclables. Labor requirements would increase due to the need for added collection crews and the sorting and processing at the MRF.

Education and promotion of the curbside recycling program would need to be undertaken in advance of operation and such efforts would need to continue after operation began. Households would need to be provided with material describing the program including days of collection, materials accepted, etc.

In order to better plan and design the curbside program, the establishment of some pilot programs in the automated and manual areas would be advisable. This would result in a better determination of recovery levels and collection needs including the number of crews in the automated and manual areas.

It is estimated that, at minimum, the time required to establish city-wide curbside recycling on Oahu would be between two and three years.

SECTION 4
CONCLUSION FROM ANALYSIS

The results of the study of curbside recycling, as presented in this report, do not support a conclusion that curbside recycling should be implemented on Oahu. City-wide, the cost of curbside recycling was estimated to increase average single-family solid waste management costs between one and two dollars per month (Table 12) or about six to 10 percent depending upon frequency of collection. In return, separate collection of single-family household materials for recycling would increase an estimated 10 percentage points over that with only the proposed/expanded drop-off recycling program.

However, nearly all of the materials that would be recovered through curbside recycling would still be recovered for recycling or used for energy if curbside recycling were *not* implemented. H-POWER, which currently receives the single-family household refuse, recovers the metal cans for recycling and combusts the organic materials. The paper and plastic materials received at H-POWER both have comparatively high heat energy value, which is used to generate electricity. Thus, all of the materials that would be collected through curbside recycling, except glass containers, are currently being used for energy or recovered for recycling. The glass containers that would be collected through curbside recycling were estimated at approximately 1.5 percent of single-family municipal solid waste (by weight).

While reducing the use of landfill space may be an important consideration on Oahu, curbside recycling would likely have an insignificant effect on this objective. (The reduction in disposal due to a curbside program is estimated to be 39,000 to 41,000 tons per year compared to the total of 820,000 tons that were disposed in 1998.) Further, the materials that would be collected through a curbside program, except for glass, are currently being used in a manner that preserves natural resources. Given these facts, it is difficult to see the justification for increasing the cost of residential solid waste management on Oahu by $2.4 million to $3.6 million per year to operate a curbside recycling program.

APPENDIX

Appendix Table 1
Scenario 2
Automated Curbside Recovery Estimates from Average Single-Family Household in Honolulu
At 90% Household Participation & Including Currently Recovered Drop-Off Recyclables (1)

Recyclables for Curbside Programs	% of Collected Refuse	Quantities Collected As Refuse (lb/HH/Wk)	Quantities Collected in Drop-Offs (lb/HH/Wk)	Total S-F Curbside Recyclables (lb/HH/Wk)	Recovery with Curbside Recycling			Curbside recovery (% by Material)	Uncompacted Densities (lb/cu yd)	Volume Needed (cu yds/ 100 lb)
					HH Participation (%)	Capture Rates (%)	Recovery (lb/HH/Wk)			
Paper:										
ONP	6.40	4.21	0.56	4.77	90	95	4.08	43.95	550	0.08
Cardboard	4.70	3.09	0.32	3.41	90	75	2.30	24.82	300	0.08
High Grade	1.10	0.72	0.09	0.81	90	90	0.66	7.10	600	0.01
Subtotal Paper	12.20	8.03	0.97	9.00			7.04	75.86		0.17
Containers:										
PET Bottles	0.50	0.33	0.04	0.37	90	63	0.21	2.26	32	0.07
HDPE Bottles	0.70	0.46	0.05	0.51	90	57	0.26	2.83	30	0.09
Aluminum Cans	0.58	0.38	0.05	0.43	90	60	0.23	2.48	54	0.05
Steel/Tin Cans	1.23	0.81	0.08	0.89	90	53	0.43	4.59	127	0.04
Glass Containers	2.18	1.43	0.21	1.65	90	75	1.11	11.97	395	0.03
Subtotal Containers	5.19	3.42	0.43	3.85			2.24	24.14		0.28
Subtotal of Recyclables	17.39	11.45	1.40	12.85			9.29	100.00		0.45
Remaining Refuse	82.61	54.38						Recyclables Density =		221.31 lb/cu yd
Totals (2)	100.00	65.82								

(1) Total collected refuse quantity based on data from City and County of Honolulu Refuse Division.
Breakdown of recyclable materials based on three sampling periods from Honolulu Waste Stream Composition Study conducted by Cascadia Consulting Group.
Other factors used in recovery estimates from Franklin Associates.

(2) Estimated total refuse collection including green waste from average single-family household.

Source: Franklin Associates

Appendix Table 2
Scenario 2
Manual Curbside Recovery Estimates from Average Single-Family Household in Honolulu
At 70% Household Participation & *Including* Currently Recovered Drop-Off Recyclables (1)

Recyclables for Curbside *Programs*	% of Collected Refuse	Quantities Collected As Refuse (lb/HH/Wk)	Quantities Collected In Drop-Offs (lb/HH/Wk)	Total S-F Curbside Recyclables (lb/HH/Wk)	Recovery with Curbside Recycling: HH Participation (%)	Capture Rates (%)	Recovery (lb/HH/Wk)	Curbside recovery (% by Material)	Uncompacted Densities (lb/cu yd)	Volume Needed (cu yds/ 100 lb)
Paper:										
ONP	6.40	4.21	0.56	4.77	70	95	3.17	58.45	550	0.11
High Grade	1.10	0.72	0.09	0.81	70	90	0.51	9.45	600	0.02
Subtotal Paper	7.50	4.94	0.65	5.59			3.69	67.90		0.12
Containers:										
PET Bottles	0.50	0.33	0.04	0.37	70	63	0.16	3.00	32	0.09
HDPE Bottles	0.70	0.46	0.05	0.51	70	57	0.20	3.77	30	0.13
Aluminum Cans	0.58	0.38	0.05	0.43	70	60	0.18	3.30	54	0.06
Steel/Tin Cans	1.23	0.81	0.08	0.89	70	53	0.33	6.11	127	0.05
Glass Containers	2.18	1.43	0.21	1.65	70	75	0.86	15.92	395	0.04
Subtotal Containers	5.19	3.42	0.43	3.85			1.74	32.10		0.37
Subtotal of Recyclables	12.69	8.35	1.08	9.44			5.43	100.00		0.49
Remaining Refuse	87.31	57.47						Recyclables Density =		203.67 lb/cu yd
Totals (2)	100.00	65.82								

(1) Total collected refuse quantity based on data from City and County of Honolulu Refuse Division.
Breakdown of recyclable materials based on three sampling periods from Honolulu Waste Stream Composition Study conducted by Cascadia Consulting Group.
Other factors used in recovery estimates from Franklin Associates.

(2) Estimated total refuse collection including green waste from average single-family household.

Source: Franklin Associates

Appendix Table 3
Scenario 4
Automated Curbside Recovery Estimates from Average Single-Family Household in Honolulu
At 90% Household Participation & Including Proposed Drop-Off Program (1)

Recyclables for Curbside Programs	% of Collected Refuse	Quantities Collected As Refuse (lb/HH/Wk)	Quantities Collected in Drop-Offs (lb/HH/Wk)	Quantities Remaining in Drop-Offs (2) (lb/HH/Wk)	Total S-F Curbside Recyclables (lb/HH/Wk)	Recovery with Curbside Recycling: HH Participation (%)	Capture Rates (%)	Recovery (lb/HH/Wk)	Curbside recovery (% by Material)	Uncompacted Densities (lb/cu yd)	Volume Needed (cu yds/ 100 lb)
Paper:											
ONP	6.21	4.06	0.71	0.36	4.41	90	95	3.77	43.75	550	0.08
Cardboard	4.59	3.00	0.41	0.20	3.21	90	75	2.16	25.09	300	0.08
High Grade	1.06	0.70	0.11	0.06	0.75	90	90	0.61	7.07	600	0.01
Subtotal Paper	11.86	7.76	1.23	0.62	8.37			6.55	75.91		0.17
Containers:											
PET Bottles	0.49	0.32	0.05	0.03	0.34	90	63	0.20	2.26	32	0.07
HDPE Bottles	0.68	0.44	0.07	0.03	0.48	90	57	0.24	2.84	30	0.09
Aluminum Cans	0.57	0.37	0.06	0.03	0.40	90	60	0.22	2.51	54	0.05
Steel/Tin Cans	1.20	0.78	0.11	0.05	0.84	90	53	0.40	4.62	127	0.04
Glass Containers	2.11	1.38	0.27	0.13	1.52	90	75	1.02	11.86	395	0.03
Subtotal Containers	5.04	3.30	0.55	0.28	3.57			2.08	24.09		0.28
Subtotal of Recyclables	16.90	11.06	1.78	0.89	11.95			8.63	100.00		0.45
Remaining Refuse	83.10	54.36							Recyclables Density =		220.67 lb/cu yd
Totals (3)	100.00	65.42									

(1) Total collected refuse quantity based on data from City and County of Honolulu Refuse Division less added recovery from proposed drop-off program.
Breakdown of recyclable materials collected as refuse reflects recyclables generation estimates used in Scenario 2 less estimated recovery in proposed drop-off program.
Other factors used in recovery estimates from Franklin Associates.
(2) Assumes that 50 percent of recyclables collected in proposed drop-off program *without* curbside recycling will be collected in drop-offs *with* curbside recycling.
(3) Estimated total refuse collection after recovery from proposed drop-off program; includes green waste from average single-family household.

Source: Franklin Associates

Appendix Table 4
Scenario 4
Manual Curbside Recovery Estimates from Average Single-Family Household in Honolulu
At 75% Household Participation & Including Proposed Drop-Off Program (1)

Recyclables for Curbside Programs	% of Collected Refuse	Quantities Collected As Refuse (lb/HH/Wk)	Quantities Collected in Drop-Offs (lb/HH/Wk)	Quantities Remaining in Drop-Offs (2) (lb/HH/Wk)	Total S-F Curbside Recyclables (lb/HH/Wk)	Recovery with Curbside Recycling			Curbside recovery (% by Material)	Uncompacted Densities (lb/cu yd)	Volume Needed (cu yds/ 100 lb)
						HH Participation (%)	Capture Rates (%)	Recovery (lb/HH/Wk)			
Paper:											
ONP	6.21	4.06	0.71	0.36	4.41	75	95	3.15	58.40	550	0.11
High Grade	1.06	0.70	0.11	0.06	0.75	75	90	0.51	9.44	600	0.02
Subtotal Paper	7.27	4.76	0.82	0.41	5.17			3.65	67.84		0.12
Containers:											
PET Bottles	0.49	0.32	0.05	0.03	0.34	75	63	0.16	3.02	32	0.09
HDPE Bottles	0.68	0.44	0.07	0.03	0.48	75	57	0.20	3.79	30	0.13
Aluminum Cans	0.57	0.37	0.06	0.03	0.40	75	60	0.18	3.35	54	0.06
Steel/Tin Cans	1.20	0.78	0.11	0.05	0.84	75	53	0.33	6.17	127	0.05
Glass Containers	2.11	1.38	0.27	0.13	1.52	75	75	0.85	15.83	395	0.04
Subtotal Containers	5.04	3.30	0.55	0.28	3.57			1.73	32.16		0.37
Subtotal of Recyclables	12.31	8.05	1.38	0.69	8.74			5.39	100.00		0.49
Remaining Refuse	87.69	57.37							Recyclables Density =		202.72 lb/cu yd
Totals (3)	100.00	65.42									

(1) Total collected refuse quantity based on data from City and County of Honolulu Refuse Division less added recovery from proposed drop-off program.
Breakdown of recyclable materials collected as refuse reflects recyclables generation estimates used in Scenario 2 less estimated recovery in proposed drop-off program.
Other factors used in recovery estimates from Franklin Associates.

(2) Assumes that 50 percent of recyclables collected in proposed drop-off program *without* curbside recycling will be collected in drop-offs *with* curbside recycling.

(3) Estimated total refuse collection after recovery from proposed drop-off program; includes green waste from average single-family household.

Source: Franklin Associates

Appendix Table 5
Scenario 1
Automated Refuse Collection Cost With 50% Less Green Waste
And With Proposed Drop-Off Recycling
And Twice Weekly Refuse Collection
(Ave. of 14.83 Tons/Day/Crew, 6 Days/Week)

Capital Cost Items:	**Costs (in dollars)**
Truck Chassis & Body--24 cubic yard automated packer (includes $6,000 for spare parts)	216,000
Spare Trucks--assume 40% backup	86,400
96 Gallon Carts--assume 3 routes of 1,024 hshlds. each @ $62/cart plus one percent more for hshlds. needing 2 carts	192,369
Total Equipment Capital Cost	494,769
Annual Cost Items:	
Truck Amortization--6 years life, no resale, 6% interest	61,497
Cart Amortization--10 years life, no resale, 6% interest	26,137
Direct Salaries/Wages--1.75 persons to cover 60 hours/week and allowance for leave (vacation, sick leave, holidays, etc.)	48,922
Labor Fringe Benefits--37.54% of wages	18,365
Indirect Costs (Administrative, etc.) (1)	8,317
Current Expenses (1)	450
Maintenance (Repairs, Fuel, Tires)--assumes $25,000/vehicle (2)	35,000
Total Annual Cost	198,687
Cost Per Hour--assumes 60 hours/week, 3120 hours/year	64
Cost Per Ton Factor:	
Assume 14.83 tons/day X 6 days/week X 52 = 4,627 tons/year	
Cost Per Ton	42.94

(1) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.
(2) From representative of City and County of Honolulu Refuse Division.

Source: Franklin Associates

Appendix Table 6
Scenario 1
Manual Waste Collection Cost with 50% Less Green Waste
And With Proposed Drop-Off Recycling
And Twice Weekly Refuse Collection
(Ave. of 8.63 Tons/Day/Crew, 6 Days/Week)

Capital Cost Items:	**Costs (in dollars)**
Truck Chassis & Body--20 cubic yard manual packer (includes $6,000 for spare parts)	142,000
Spare Trucks--assume 40% backup	56,800
Total Equipment Capital Cost	198,800
Annual Cost Items:	
Truck Amortization--8 years life, no resale, 6% interest	32,014
Direct Salaries/Wages--1.40 multiplier to cover 48 hours/week and allowance for leave (vacation, sick leave, holidays, etc.):	
Driver/Operator--one per crew times 1.40 multiplier	37,681
Collectors--two per crew times 1.40 multiplier	65,462
Labor Fringe Benefits--37.54% of wages	38,720
Indirect Costs (Administrative, etc.) (1)	17,534
Current Expenses (1)	949
Maintenance (Repairs, Fuel, Tires)--assumes $10,000/vehicle (2)	14,000
Total Annual Cost	206,360
Cost Per Hour--assumes 48 hours/week, 2496 hours/year	83
Cost Per Ton Factor:	
Assume 8.63 tons/day X 6 days/week X 52 = 2,693 tons/year	
Cost Per Ton	76.64

(1) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.
(2) From representative of City and County of Honolulu Refuse Division.

Source: Franklin Associates

Appendix Table 7
Scenario 2
Automated Refuse Collection Cost With 50% Less Green Waste
And With Curbside Recycling & No Drop-Off Recycling
And Twice Weekly Refuse Collection
(Ave. of 13.79 Tons/Day/Crew, 6 Days/Week)

Capital Cost Items:	**Costs (in dollars)**
Truck Chassis & Body--24 cubic yard automated packer (includes $6,000 for spare parts)	216,000
Spare Trucks--assume 40% backup	86,400
96 Gallon Carts--assume 3 routes of 1,098 hshlds. each @ $62/cart plus one percent more for hshlds. needing 2 carts	206,270
Total Equipment Capital Cost	508,670
Annual Cost Items:	
Truck Amortization--6 years life, no resale, 6% interest	61,497
Cart Amortization--10 years life, no resale, 6% interest	28,026
Direct Salaries/Wages--1.75 persons to cover 60 hours/week and allowance for leave (vacation, sick leave, holidays, etc.)	48,922
Labor Fringe Benefits--37.54% of wages	18,365
Indirect Costs (Administrative, etc.) (1)	8,317
Current Expenses (1)	450
Maintenance (Repairs, Fuel, Tires)--assumes $25,000/vehicle (2)	35,000
Total Annual Cost	200,576
Cost Per Hour--assumes 60 hours/week, 3120 hours/year	64
Cost Per Ton Factor:	
Assume 13.79 tons/day X 6 days/week X 52 = 4,302 tons/year	
Cost Per Ton	46.62

(1) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.
(2) From representative of City and County of Honolulu Refuse Division.

Source: Franklin Associates

Appendix Table 8
Scenario 2
Manual Waste Collection Cost with 50% Less Green Waste
And With Curbside Recycling & No Drop-Off Recycling
And Twice Weekly Refuse Collection
(Ave. of 8.29 Tons/Day/Crew, 6 Days/Week)

	Costs (in dollars)
Capital Cost Items:	
Truck Chassis & Body--20 cubic yard manual packer (includes $6,000 for spare parts)	142,000
Spare Trucks--assume 40% backup	56,800
Total Equipment Capital Cost	198,800
Annual Cost Items:	
Truck Amortization--8 years life, no resale, 6% interest	32,014
Direct Salaries/Wages--1.40 multiplier to cover 48 hours/week and allowance for leave (vacation, sick leave, holidays, etc.):	
Driver/Operator--one per crew times 1.40 multiplier	37,681
Collectors--two per crew times 1.40 multiplier	65,462
Labor Fringe Benefits--37.54% of wages	38,720
Indirect Costs (Administrative, etc.) (1)	17,534
Current Expenses (1)	949
Maintenance (Repairs, Fuel, Tires)--assumes $10,000/vehicle (2)	14,000
Total Annual Cost	206,360
Cost Per Hour--assumes 48 hours/week, 2496 hours/year	83
Cost Per Ton Factor:	
Assume 8.29 tons/day X 6 days/week X 52 = 2,586 tons/year	
Cost Per Ton	79.78

(1) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.
(2) From representative of City and County of Honolulu Refuse Division.

Source: Franklin Associates

Appendix Table 9
Scenario 4
Automated Refuse Collection Cost With 50% Less Green Waste
With Curbside Recycling & With Drop-Off Recycling
And Once Weekly Collection
(Ave. of 19.38 Tons/Day/Crew, 6 Days/Week)

Capital Cost Items:	**Costs (in dollars)**
Truck Chassis & Body--24 cubic yard automated packer (includes $6,000 for spare parts)	216,000
Spare Trucks--assume 40% backup	86,400
96 Gallon Carts--assume 6 routes of 777 hshlds. each @ $62/cart plus 15 percent more for hshlds. needing 2 carts	332,401
Total Equipment Capital Cost	634,801
Annual Cost Items:	
Truck Amortization--6 years life, no resale, 6% interest	61,497
Cart Amortization--10 years life, no resale, 6% interest	45,163
Direct Salaries/Wages--1.75 persons to cover 60 hours/week and allowance for leave (vacation, sick leave, holidays, etc.)	48,922
Labor Fringe Benefits--37.54% of wages	18,365
Indirect Costs (Administrative, etc.) (1)	8,317
Current Expenses (1)	450
Maintenance (Repairs, Fuel, Tires)--assumes $30,000/vehicle (2)	42,000
Total Annual Cost	224,713
Cost Per Hour--assumes 60 hours/week, 3120 hours/year	72
Cost Per Ton & Per Household Factors:	
Assume 19.38 tons/day X 6 days/week X 52 = 6,047 tons/year	
Cost Per Ton	37.16

(1) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.
(2) Assumes that the increase in quantity collected per crew per day will increase vehicle maintenance costs approximately 20 percent.

Source: Franklin Associates

Appendix Table 10
Scenario 4
Manual Refuse Collection Cost with 50% Less Green Waste
With Curbside Recycling & With Drop-Off Recycling
With Once Weekly Collection & 24,000 Pounds/Day/Crew Limit
(Ave. of 12 Tons/Day/Crew, 6 Days/Week)

Capital Cost Items:	**Costs (in dollars)**
Truck Chassis & Body--20 cubic yard manual packer (includes $6,000 for spare parts)	142,000
Spare Trucks--assume 40% backup	56,800
Total Equipment Capital Cost	198,800
Annual Cost Items:	
Truck Amortization--8 years life, no resale, 6% interest	32,014
Direct Salaries/Wages--1.40 multiplier to cover 48 hours/week and allowance for leave (vacation, sick leave, holidays, etc.):	
Driver/Operator--one per crew times 1.40 multiplier	37,681
Collectors--two per crew times 1.40 multiplier	65,462
Labor Fringe Benefits--37.54% of wages	38,720
Indirect Costs (Administrative, etc.) (1)	17,534
Current Expenses (1)	949
Maintenance (Repairs, Fuel, Tires)--assumes $10,000/vehicle (2)	18,200
Total Annual Cost	210,560
Cost Per Hour--assumes 48 hours/week, 2496 hours/year	84
Cost Per Ton & Per Household Factors:	
Assume 12 tons/day X 6 days/week X 52 = 3,744 tons/year	
Cost Per Ton	56.24

(1) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.
(2) From representative of City and County of Honolulu Refuse Division.

Source: Franklin Associates

Appendix Table 11
Scenario 2
Automated Recyclables Collection Cost
With Bi-Weekly Collection (1)
(Ave. of 1,042 Households & 9.68 Tons/Day/Crew, 6 Days/Week)

	Costs (in dollars)
Capital Cost Items:	
Truck Chassis & Body--24 cubic yard automated packer (includes $6,000 for spare parts)	216,000
Spare Trucks--assume 40% backup	86,400
Subtotal Trucks	302,400
65-Gallon Carts--assume 12 routes of 1042 hshlds (12,504 hshlds) and $58/cart.	725,232
Total Equipment Capital Cost	1,027,632
Annual Cost Items:	
Truck Amortization--6 years life, no resale, 6% interest	61,497
Cart Amortization--10 years life, no resale, 6% interest	98,536
Direct Salaries/Wages--1.75 persons to cover 60 hours/week and allowance for leave (vacation, sick leave, holidays, etc.)	48,922
Labor Fringe Benefits--37.54% of wages	18,365
Indirect Costs (Administrative, etc.) (2)	8,317
Current Expenses (2)	450
Maintenance (Repairs, Fuel, Tires)--assumes $25,000/vehicle	35,000
Promotion of Program--$1.50/hshld/year for 12,504 Hshlds	16,416
Total Annual Cost	287,502
Cost Per Hour--assumes 60 hours/week, 3120 hours/year	92
Cost Per Ton & Per Household Factors:	
Assume 9.68 tons/day X 6 days/week X 52 = 3,020 tons/year	
Households served = 1,042/day X 12 routes = 12,504	
Cost Per Ton	95.19
Cost Per Household Per Month	1.92

(1) Assumes one-person crew operating 10 hours per day, 6 days per week.
(2) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study draft report.

Source: Franklin Associates

Appendix Table 12
Scenario 2
Manual Recyclables Collection Cost
With Bi-Weekly Collection (1)
(Ave. of 700 Housholds & 3.80 Tons/Day/Crew, 6 Days/Week)

	Costs (in dollars)
Capital Cost Items:	
Truck Chassis & Body--42 cubic yard with side-loading automated-lift hopper; 2 compartments with light compaction (includes $4,500 for spare parts)	124,100
Spare Trucks--assume 20% backup	24,820
Subtotal Trucks	148,920
18-Gallon Curbside Containers--assume 12 routes of 700 hshlds (8,400 hshlds) and $7/container	58,800
Total Equipment Capital Cost	207,720
Annual Cost Items:	
Truck Amortization--8 years life, no resale, 6% interest	23,981
Container Amortization--10 years life, no resale, 6% interest	9,469
Direct Salaries/Wages--1.40 multiplier to cover 48 hours/week and allowance for leave (vacation, sick leave, holidays, etc.):	
Driver/Operator--one per crew times 1.40 multiplier	39,137
Labor Fringe Benefits--37.54% of wages	14,692
Indirect Costs (Administrative, etc.) (2)	6,653
Current Expenses (2)	360
Maintenance (Repairs, Fuel, Tires)--assumes $25,000/vehicle	30,000
Container Replacement--5% per year	2,940
Promotion of Program--$1.50/hshld/year; 8,400 Hshlds	12,600
Total Annual Cost	139,833
Cost Per Hour--assumes 48 hours/week, 2496 hours/year	56
Cost Per Ton & Per Household Factors:	
Assume 3.80 tons/day X 6 days/week X 52 = 1,186 tons/year	
Households served = 700/day X 12 routes = 8,400	
Cost Per Ton	117.94
Cost Per Household Per Month	1.39

(1) Assumes one-person crew operating 8 hours per day, 6 days per week.
(2) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.

Source: Franklin Associates

Appendix Table 13
Scenario 4
Automated Recyclables Collection Cost
With Once/Week Collection (1)
(Ave. of 1,503 Households & 6.49 Tons/Day/Crew, 6 Days/Week)

	Costs (in dollars)
Capital Cost Items:	
Truck Chassis & Body--24 cubic yard automated packer (includes $6,000 for spare parts)	216,000
Spare Trucks--assume 40% backup	86,400
Subtotal Trucks	302,400
65-Gallon Carts--assume 6 routes of 1503 hshlds (9018 hshlds) and $58/cart.	523,044
Total Equipment Capital Cost	825,444
Annual Cost Items:	
Truck Amortization--6 years life, no resale, 6% interest	61,497
Cart Amortization--10 years life, no resale, 6% interest	71,065
Direct Salaries/Wages--1.75 persons to cover 60 hours/week and allowance for leave (vacation, sick leave, holidays, etc.)	48,922
Labor Fringe Benefits--37.54% of wages	18,365
Indirect Costs (Administrative, etc.) (2)	8,317
Current Expenses (2)	450
Maintenance (Repairs, Fuel, Tires)--assumes $25,000/vehicle	35,000
Promotion of Program--$1.50/hshld/year for 9018 Hshlds	13,527
Total Annual Cost	257,142
Cost Per Hour--assumes 60 hours/week, 3120 hours/year	82
Cost Per Ton & Per Household Factors:	
Assume 6.49 tons/day X 6 days/week X 52 = 2,025 tons/year	
Households served = 1503/day X 6 routes = 9,018	
Cost Per Ton	126.99
Cost Per Household Per Month	2.38

(1) Assumes one-person crew operating 10 hours per day, 6 days per week.
(2) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study draft report.

Source: Franklin Associates

Appendix Table 14
Scenario 4
Manual Recyclables Collection Cost
With Once/Week Collection (1)
(Ave. of 1,090 Housholds & 2.94 Tons/Day/Crew, 6 Days/Week)

	Costs (in dollars)
Capital Cost Items:	
Truck Chassis & Body--42 cubic yard with side-loading automated-lift hopper; 2 compartments with light compaction (includes $4,500 for spare parts)	124,100
Spare Trucks--assume 20% backup	24,820
Subtotal Trucks	148,920
18-Gallon Curbside Containers--assume 6 routes of 1,090 hshlds (6,540 hshlds) and $7/container	45,780
Total Equipment Capital Cost	194,700
Annual Cost Items:	
Truck Amortization--8 years life, no resale, 6% interest	23,981
Container Amortization--10 years life, no resale, 6% interest	7,372
Direct Salaries/Wages--1.40 multiplier to cover 48 hours/week and allowance for leave (vacation, sick leave, holidays, etc.):	
Driver/Operator--one per crew times 1.40 multiplier	39,137
Labor Fringe Benefits--37.54% of wages	14,692
Indirect Costs (Administrative, etc.) (2)	6,653
Current Expenses (2)	360
Maintenance (Repairs, Fuel, Tires)--assumes $25,000/vehicle	30,000
Container Replacement--5% per year	2,289
Promotion of Program--$1.50/hshld/year; 6,540 Hshlds	9,810
Total Annual Cost	134,296
Cost Per Hour--assumes 48 hours/week, 2496 hours/year	54
Cost Per Ton & Per Household Factors:	
Assume 2.94 tons/day X 6 days/week X 52 = 917 tons/year	
Households served = 1,090/day X 6 routes = 6,540	
Cost Per Ton	146.41
Cost Per Household Per Month	1.71

(1) Assumes one-person crew operating 8 hours per day, 6 days per week.
(2) Based on the percentage of salary and wages reflected in Table 3-5 of the Phase I - Managed Competition Study report.

Source: Franklin Associates

Appendix Table 15
Scenarios 2 and 4
Added Processing Costs for Single Stream Recyclables Collection

Additional cost areas	Added expense	Cost per unit	
Capital Costs			
Building costs	5,000 sq ft (1)	$43.00 (2)	$215,000
Equipment costs	$750,000 (1)		$750,000
			$965,000
Operating Costs			
Debt service on the building capital costs	6% for 20 years (2)		$18,744
Debt service on equipment	6% for 10 years (2)		$101,901
Debt service for constr. interest, startup, debt service reserve, engineering and constr., mgmt., legal & financial.	15% of debt service of $120,645		$18,100
Insurance & property taxes on 303,234 + 18,100	@ 15.5%		$49,800
Equipment maintenance	4% of capital cost (2)		$30,000
Labor costs	4 employees (1)	$18.34 (2)	$152,589
Added residue disposal on 303,234 + 18,100	@ 6%		$19,300
Profit of above (303,234 + 18,100 + 49,800 + 19,300)	@ 10%		$39,040
Annual Costs			$429,474
$ per ton (134) tons/day, 5 days/wk			$12.33

(1) RRT Design & Construction. Nathiel G. Egosi. 516-756-1060.
Equipment estimated at between $500,000 and $750,000. Use high side because of location.

(2) Multiclient study
$43.00 per sq ft at 17,300 sq ft
$13.10 per hour plus 40% fringes

Other estimates:

Los Angeles is seeing $5 to $13 less in revenue since converting to single stream
(city official Bureau of Sanitation 213-893-8536, 213-473-4425)
Charlotte, N.C. pays FCR $34 service fee per ton for 2 stream and $36 per ton for 1 stream
(Waste Age. October 1998.)

Source: Franklin Associates